



Royal Netherlands  
Meteorological Institute  
*Ministry of Infrastructure  
and the Environment*

# OMI and AURA

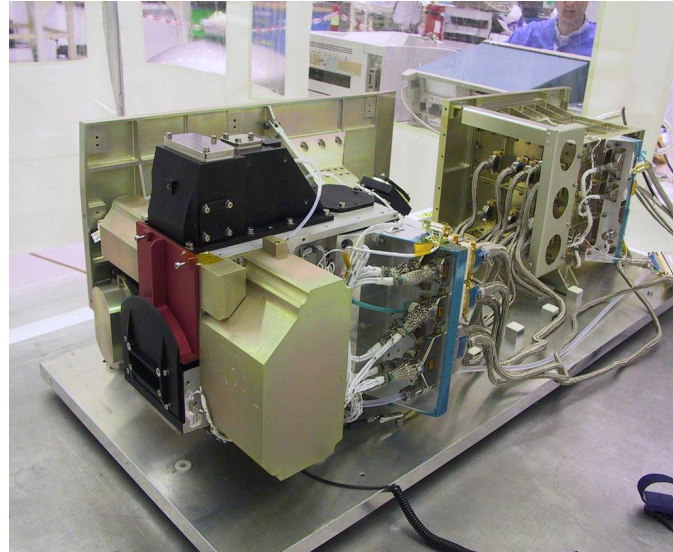
## Status Instrument, Spacecraft and Operations

MOWG  
College Park, 16 September 2014

# Presentation content

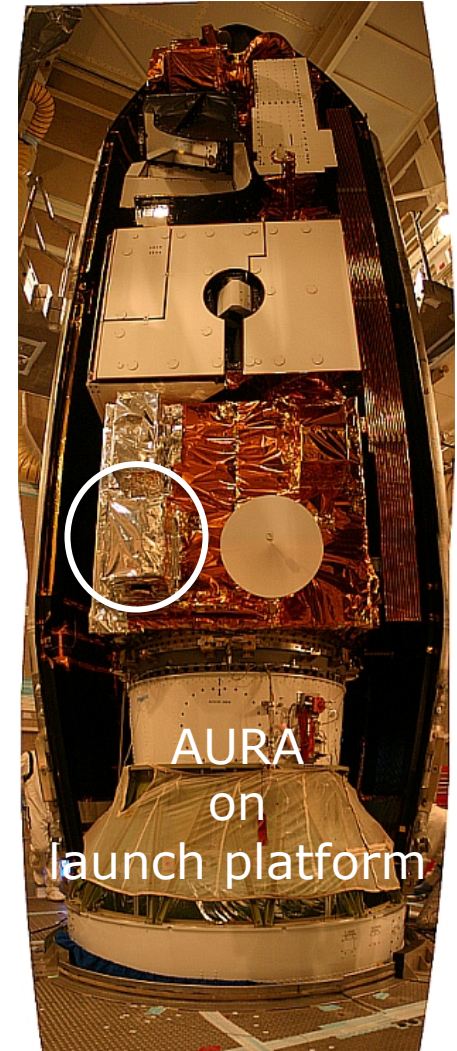


- Instrument status
- Spacecraft status
- Operations status

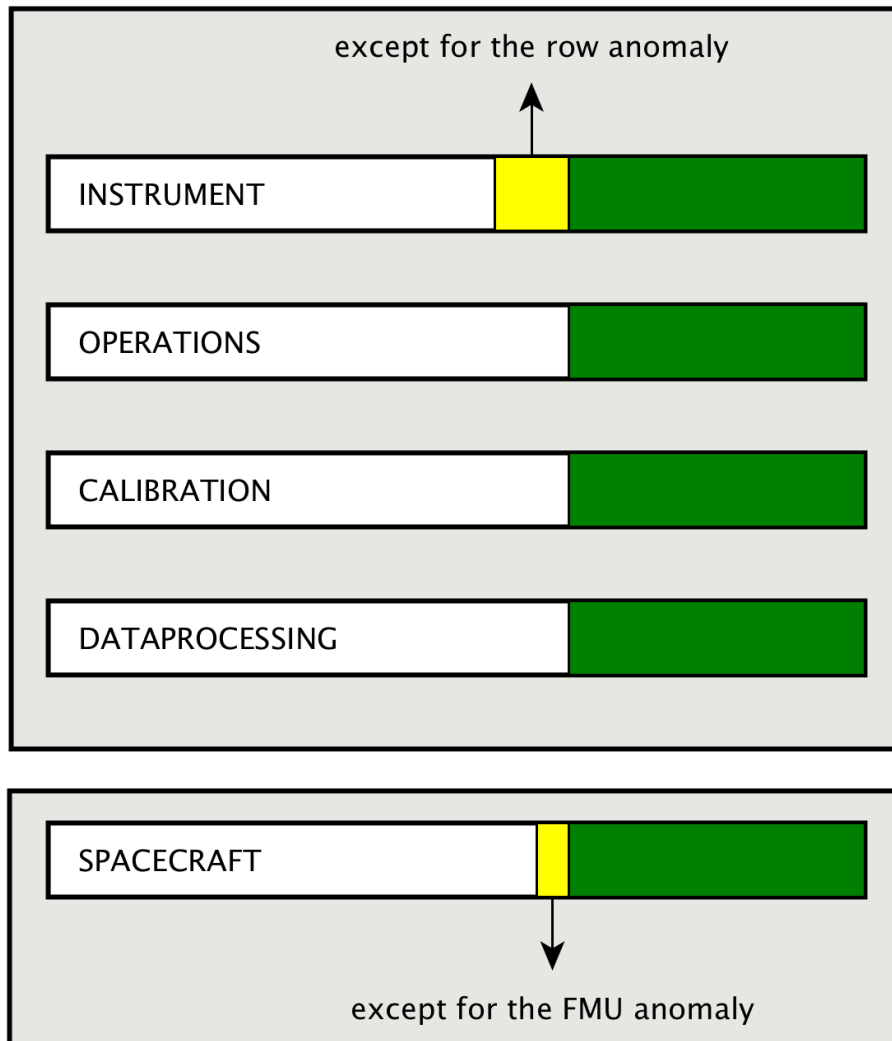


OMI flight hardware

Focus is on those items that can potentially impact the quality of the science data.



# Overall current status



INSTRUMENT  
STATUS: **ALL GREEN**

SPACECRAFT  
STATUS: **ALL GREEN**



Only three anomalies since launch that impacted the science data:

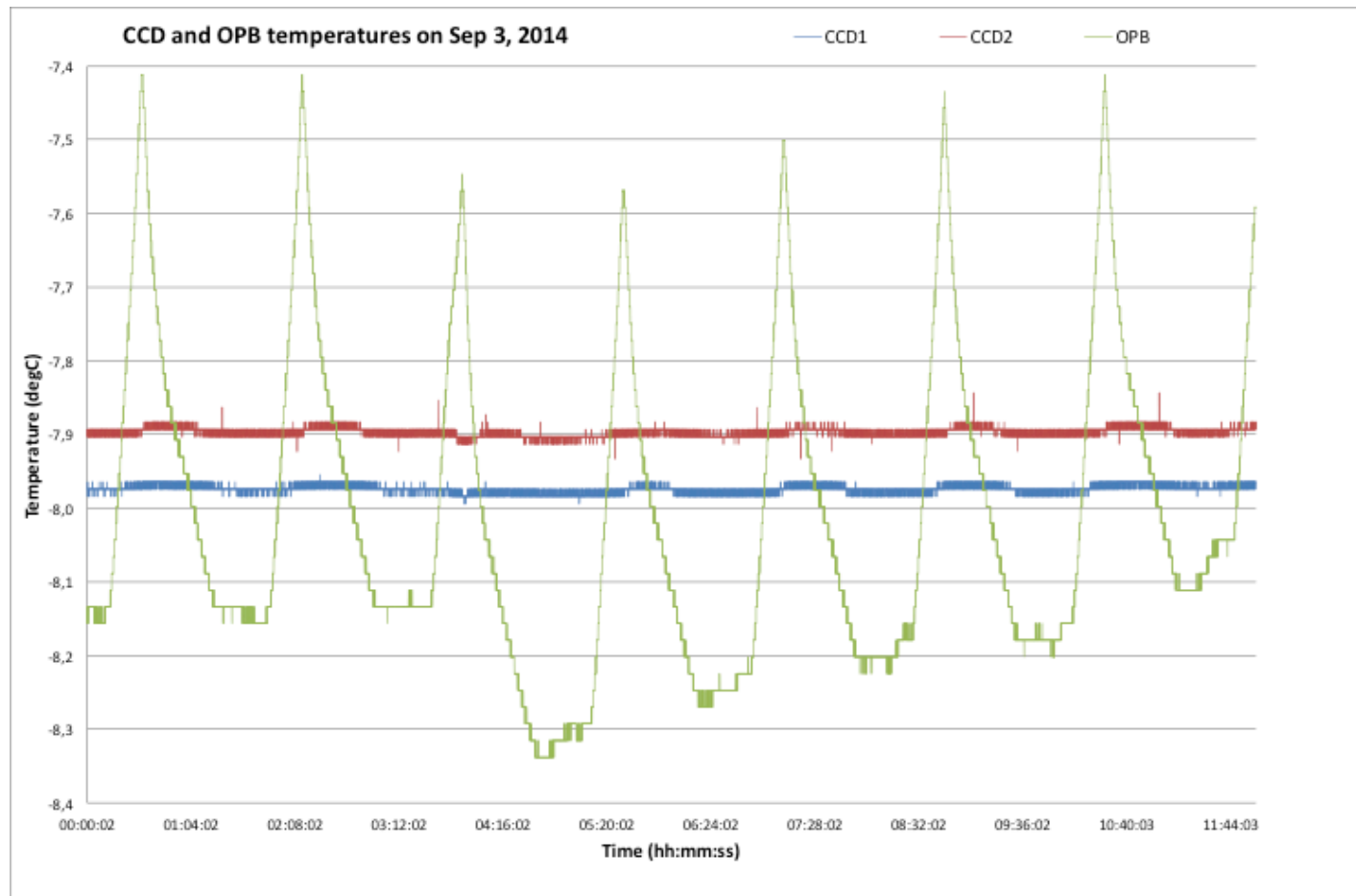
- Instrument
  - 1) Folding Mirror Mechanism anomaly in spring 2006: status solved
  - 2) Row anomaly since May 2008: status ongoing but appropriate L1B flagging scheme (identifying affected groundpixels) has been implemented
- Spacecraft
  - 3) Formatter/Multiplexer Unit anomaly since Dec. 2007: status ongoing but work-around has been implemented. No impact on the OMI science data.



- Instrument performs nominal (with exception of row anomaly)
- No other instrument anomalies
- CCD temperatures still very stable
- All three mechanisms behave nominally
- Life limited items (mechanisms, internal calibration source) within budget



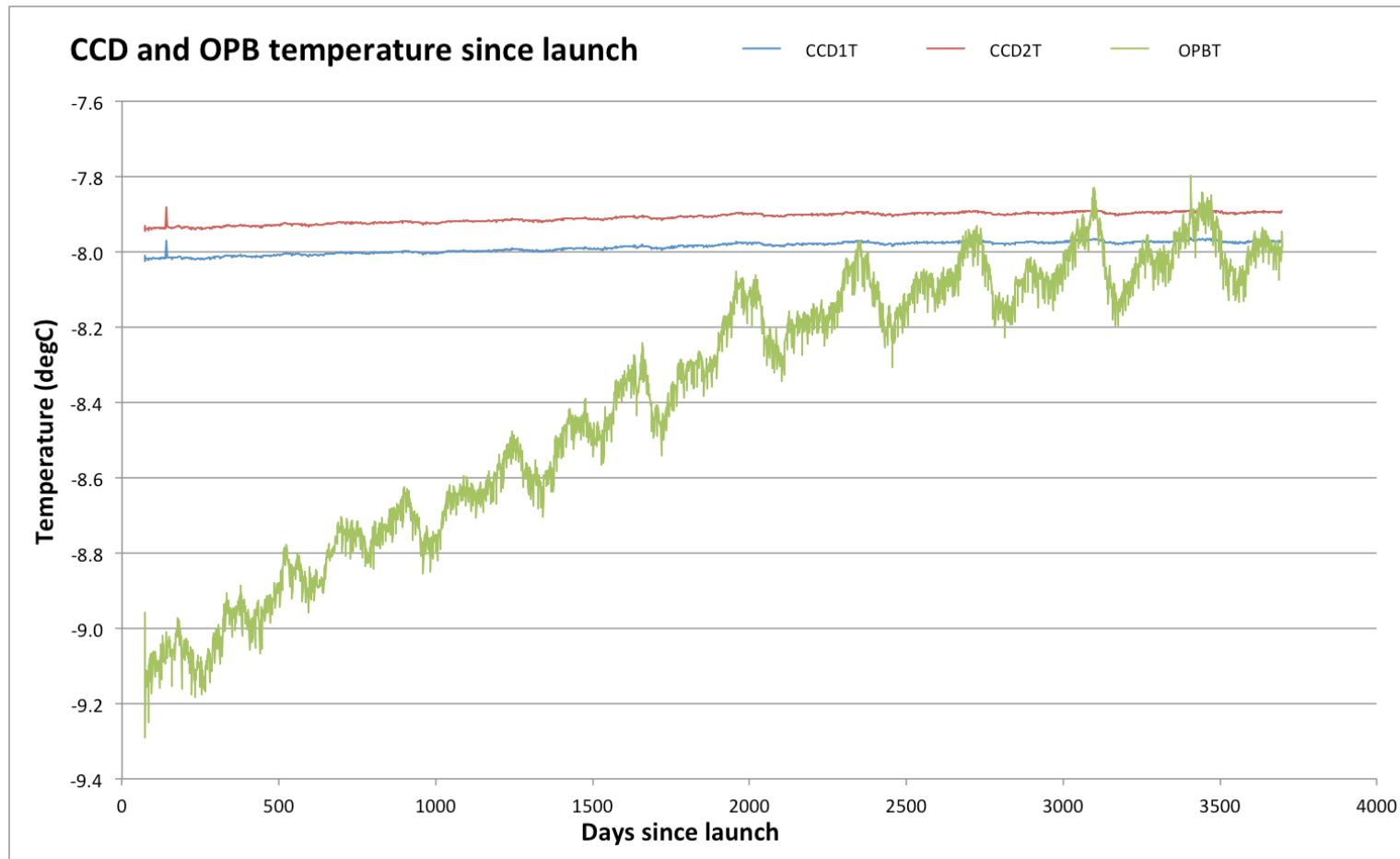
- Thermal controller keeps the CCD temperatures constant in a temperature varying optical bench. Example for Sep. 2, 2014.







- Due to the degradation of the radiator, the OPB temperature has increased over the mission, but the CCD temperatures remained almost constant.





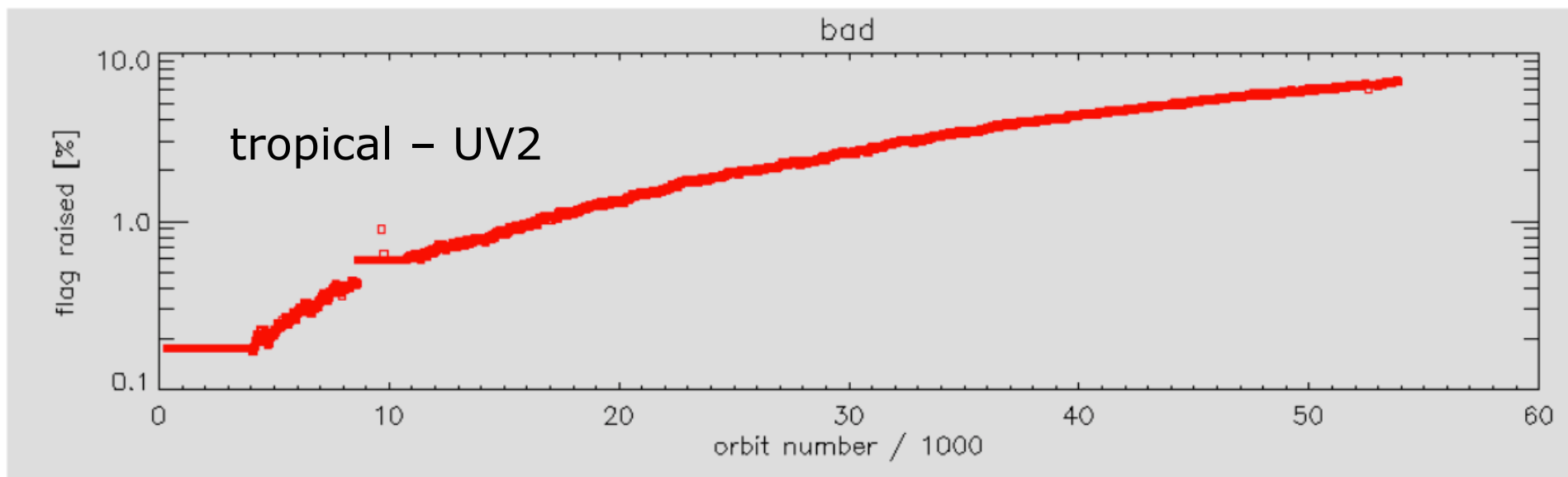
- Overall thermal stability very good; thermal settings have not changed

|                     | 2004     | 2014     | trend   |
|---------------------|----------|----------|---------|
| Optical bench       | 264.0 K  | 265.1 K  | +1.1 K  |
| UV channel CCD      | 265.13 K | 265.18 K | +0.05 K |
| VIS channel CCD     | 265.21 K | 265.26 K | +0.05 K |
| UV electronics ELU  | 290.0 K  | 290.7 K  | +0.7 K  |
| VIS electronics ELU | 291.5 K  | 292.1 K  | +0.6 K  |
| AUX electronics ELU | 289.5 K  | 290.2 K  | +0.7 K  |
| UV CCD ATC PWM      | 20 %     | 6 %      | -14. %  |
| VIS CCD ATC PWM     | 24 %     | 10 %     | -14 %   |





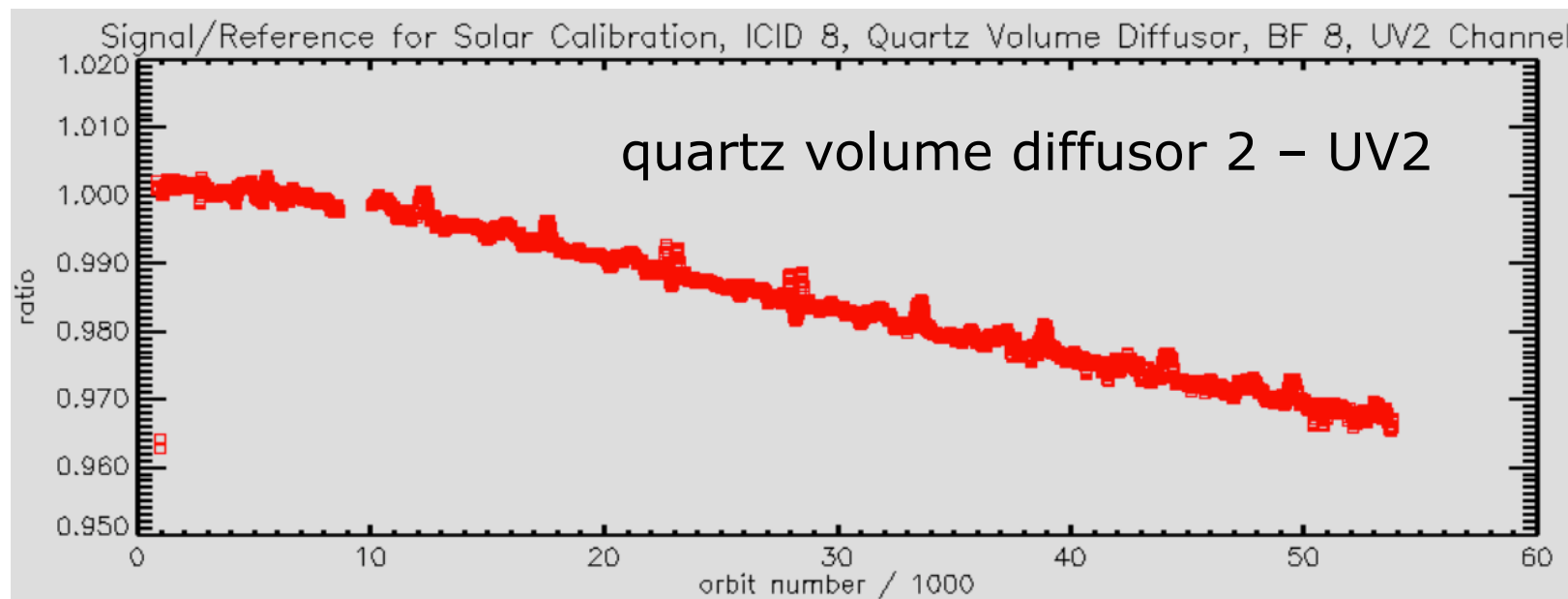
- CCD detector radiation damage (percentage of pixels flagged in L1b)



|     | tropical |     |     | midlatitude |     |     | arctic |     |     |
|-----|----------|-----|-----|-------------|-----|-----|--------|-----|-----|
|     | UV1      | UV2 | VIS | UV1         | UV2 | VIS | UV1    | UV2 | VIS |
| bad | 8%       | 7%  | 9%  | 18%         | 7%  | 9%  | 25%    | 7%  | 9%  |
| RTS | 5%       | 6%  | 5%  | 5%          | 6%  | 6%  | 6%     | 6%  | 6%  |



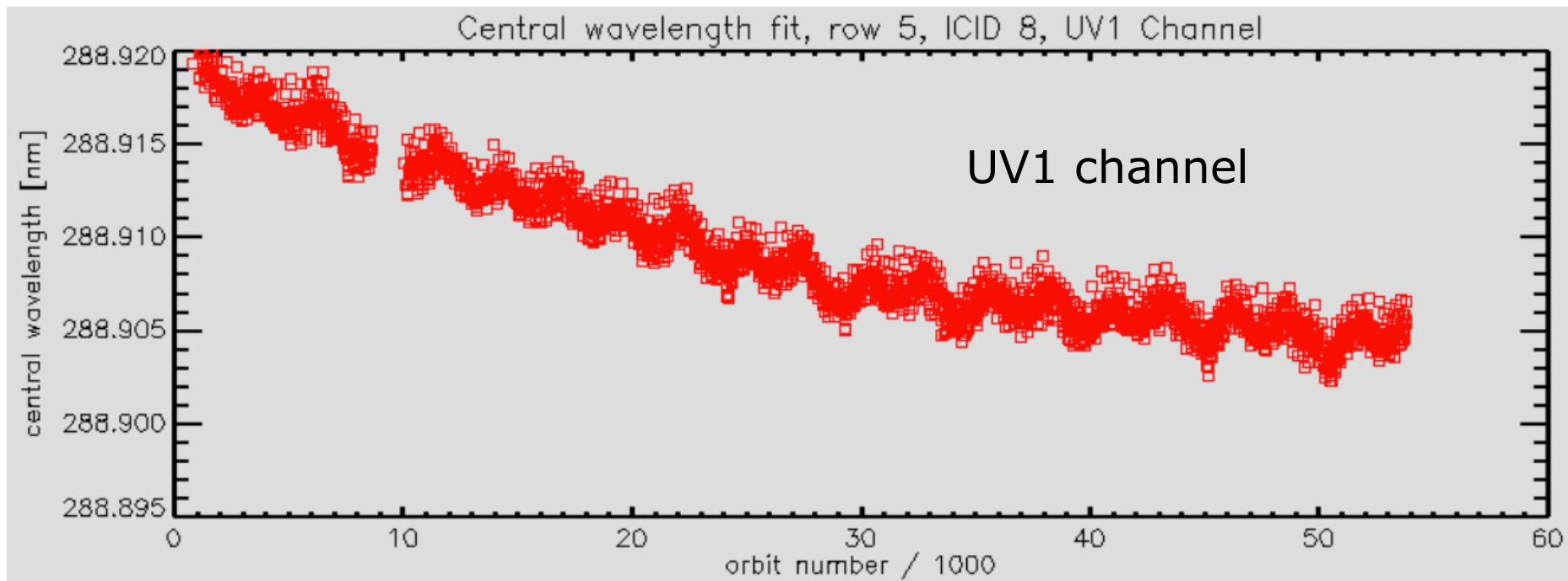
- Optical degradation extremely low: no other UVN-like instruments with such low degradation



|                     | UV1           | UV2           | VIS           |
|---------------------|---------------|---------------|---------------|
| QVD path (daily)    | 0.945         | 0.967         | 0.974         |
| ALU1 path (weekly)  | 0.972         | 0.981         | 0.980         |
| ALU2 path (monthly) | 0.980         | 0.985         | 0.984         |
| optical             | <b>-2.0 %</b> | <b>-1.5 %</b> | <b>-1.6 %</b> |
| QVD                 | -3.5 %        | -1.8 %        | -1.0 %        |



- Spectral stability irradiance



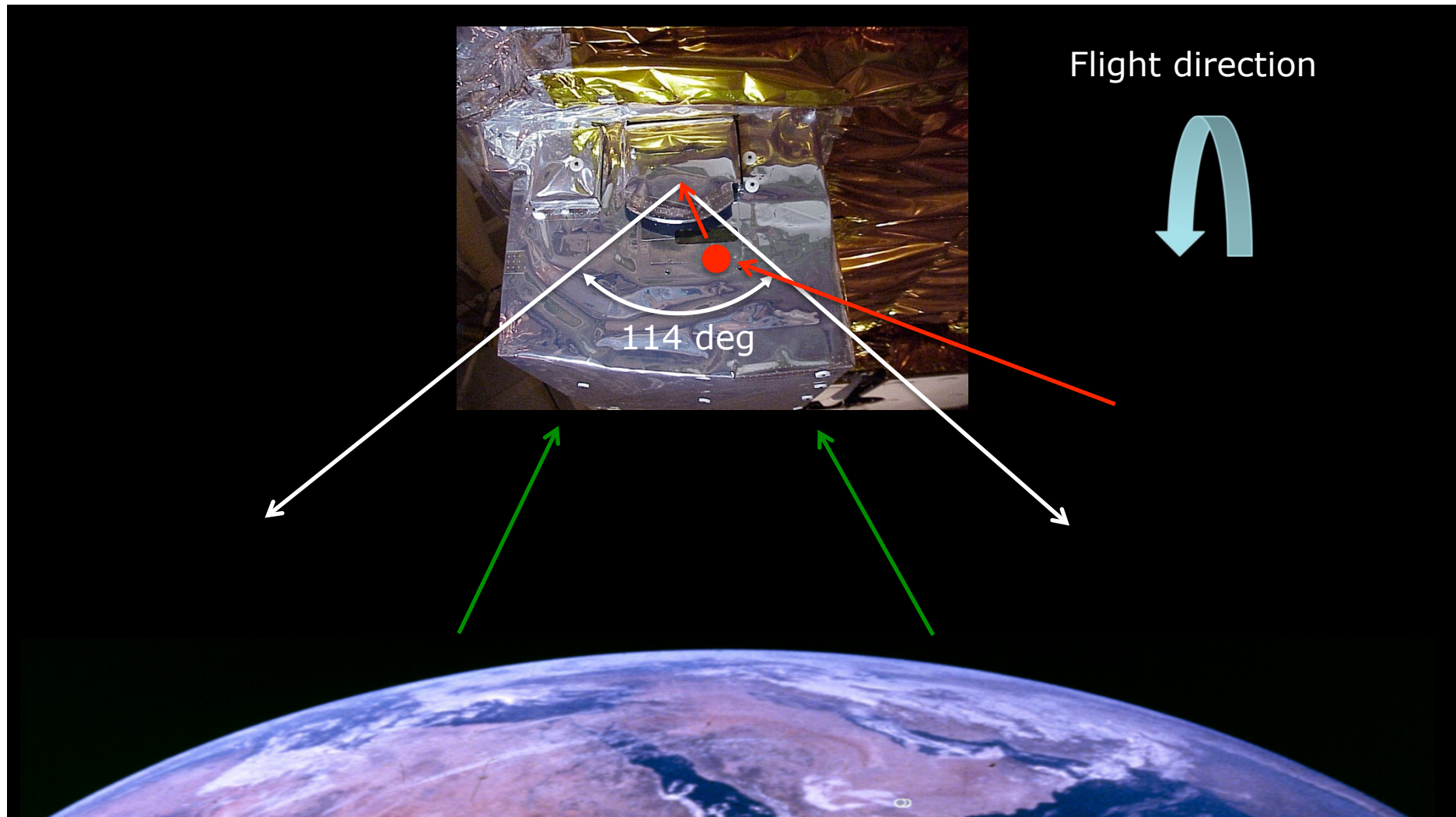
|               | UV1       | UV2      | VIS       |
|---------------|-----------|----------|-----------|
| trend         | -0.015 nm | 0.000 nm | +0.002 nm |
| seasonal [pp] | 0.002 nm  | 0.002 nm | 0.002 nm  |



- All three mechanisms and internal calibration source are far within budget
- Remaining budget, assuming unchanged operations baseline:
  - Solar Aperture Mechanism: 56 years
  - Diffuser Mechanism: 43 years
  - Folding Mirror Mechanism: 9 years
  - White Light Source: 19 years

| Description  | SAM Cycles | DifM Cycles | FMM Cycles | WLS Seconds |
|--------------|------------|-------------|------------|-------------|
| Total Used   | 6985       | 7717        | 18145      | 108441      |
| Budget       | 30916      | 30916       | 30916      | 216000      |
| Budget Spent | 22.59%     | 24.96%      | 58.69%     | 50.20%      |

Current budget (status Sep 3, 2014)





## Errors in L1b caused by the row anomaly

- **A multiplicative error**  
Caused by the partial blockage of the nadir field of view resulting in reduced radiance levels for specific rows.
- **A wavelength shift**  
Caused by inhomogeneous illumination of the spectral slit due to the blocking material, resulting in a change of the slit function.
- **Stray earthlight related additive error**  
Caused by earthlight, reflected by the blocking material from outside the OMI fov into the nadir port.
- **Stray sunlight related additive error**  
Caused by sunlight, reflected by the blocking material into the nadir port for part of the orbit.



- Affected ground pixels are flagged in the L1b product
- Row anomaly behaviour continues to change on short-term as well as long-term timescales (see next slide).
- The row anomaly is monitored on a daily basis using L1b data. Tools have been developed for this.
- Row Anomaly Monitoring (RAM) reports are generated daily and distributed to Dutch and US core team members.
- In case needed, L1b and L2 data are post-processed: update of the flags identifying affected rows. Flag definition needs approval from the OMI core team members.

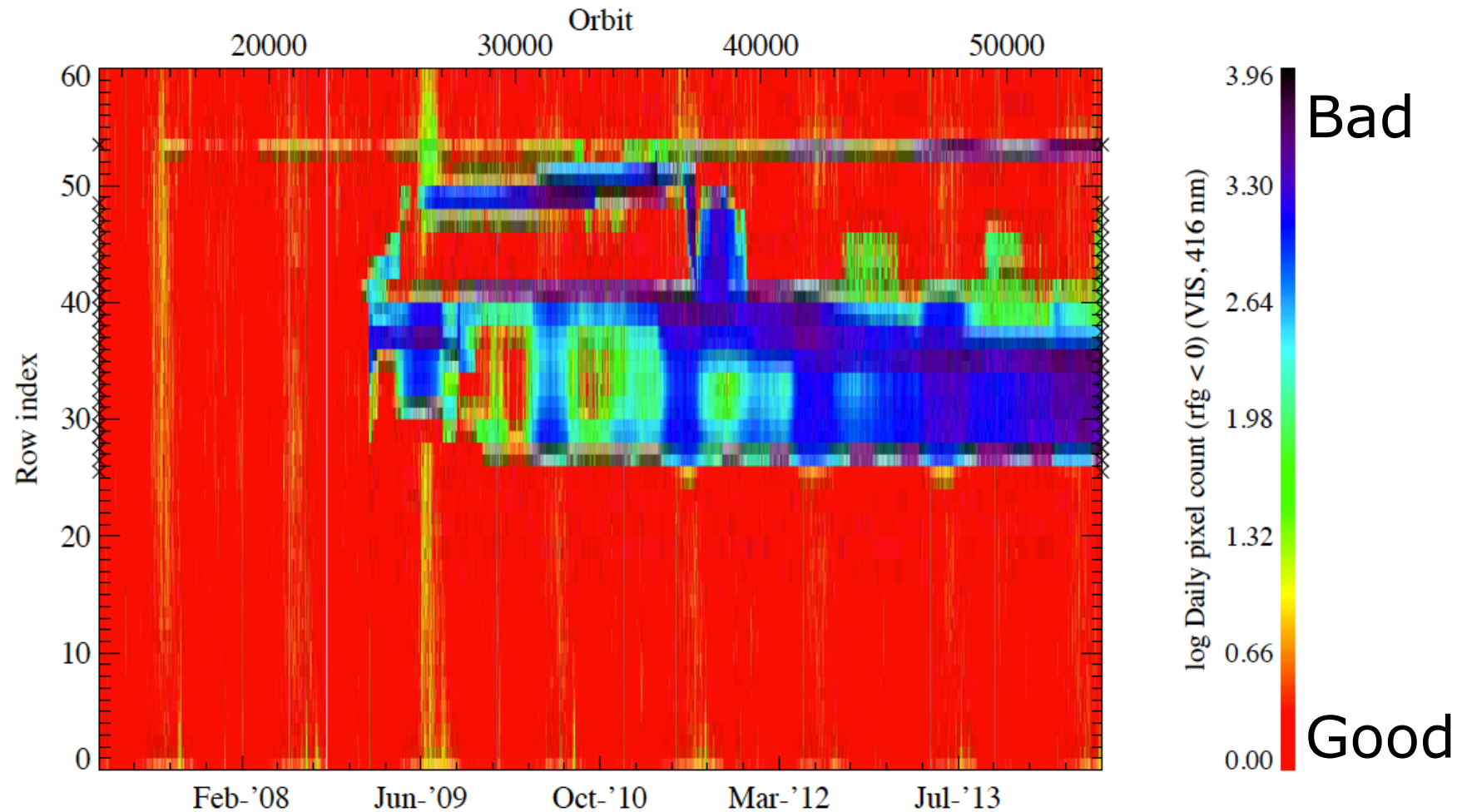


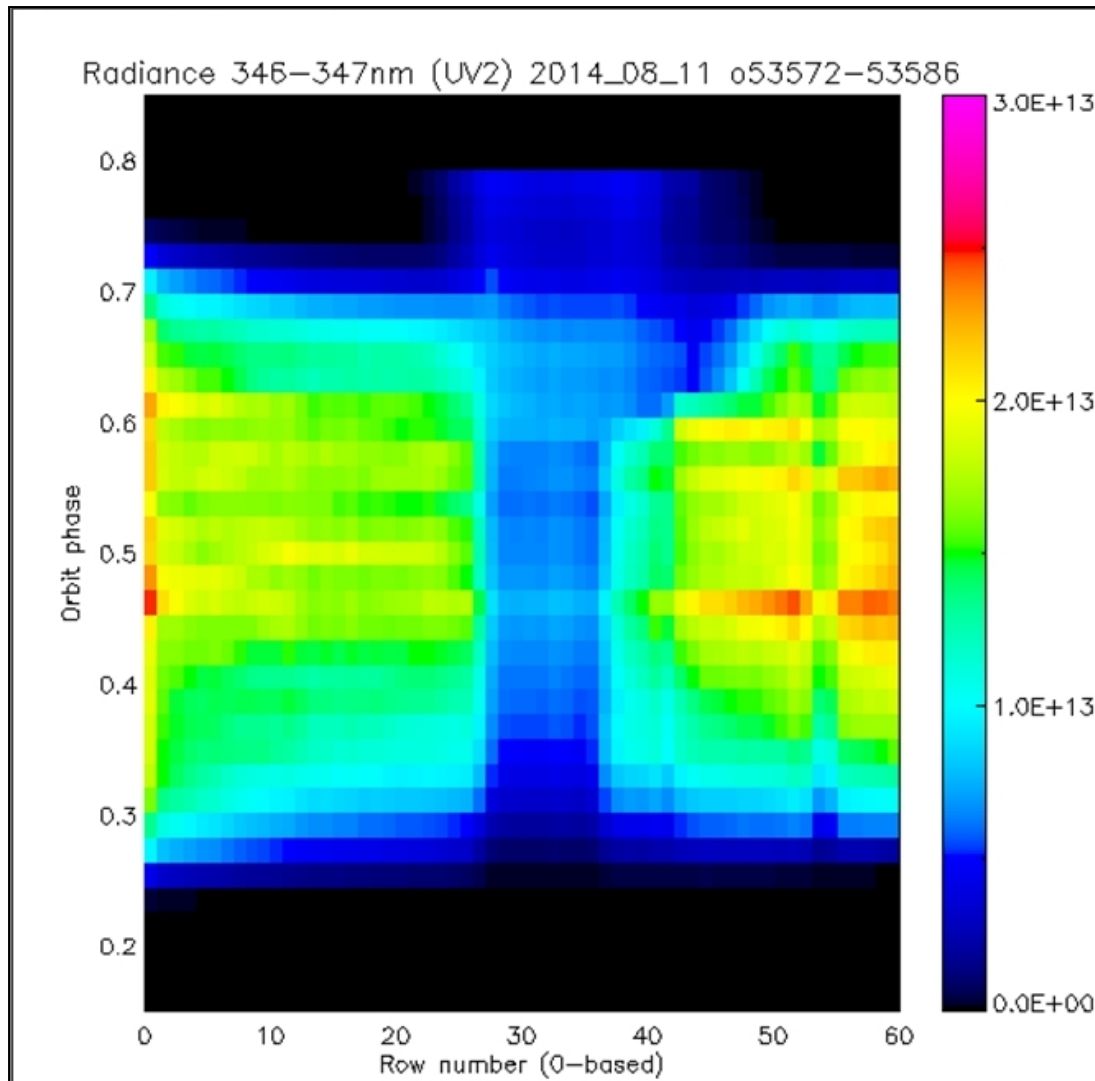
# Instrument Status



## Row anomaly: monitor

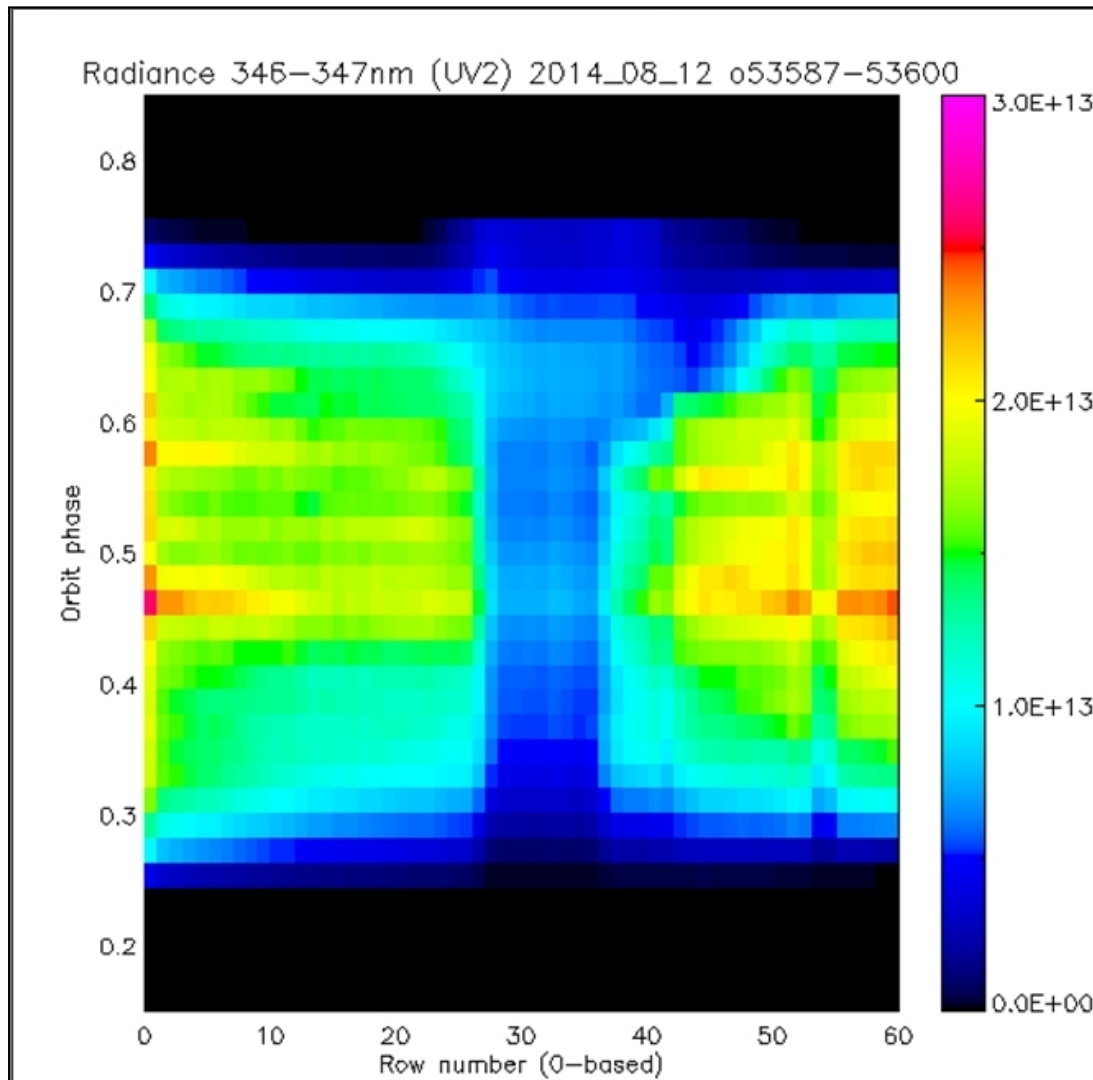
Number of negative reflectances (VIS, 416 nm) (Blockage)





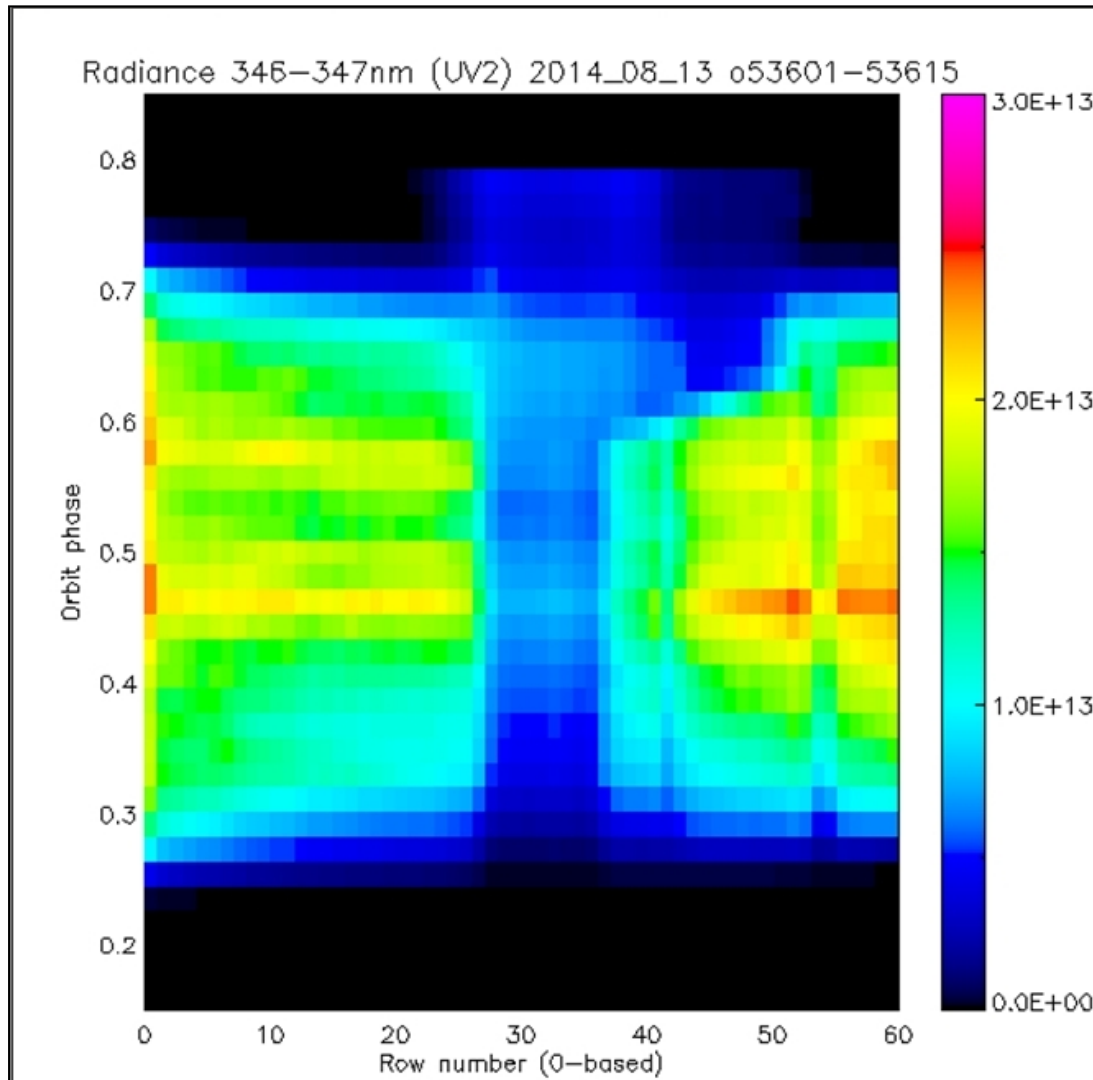
UV2 radiance daily average

August 11



UV2 radiance daily average

August 12



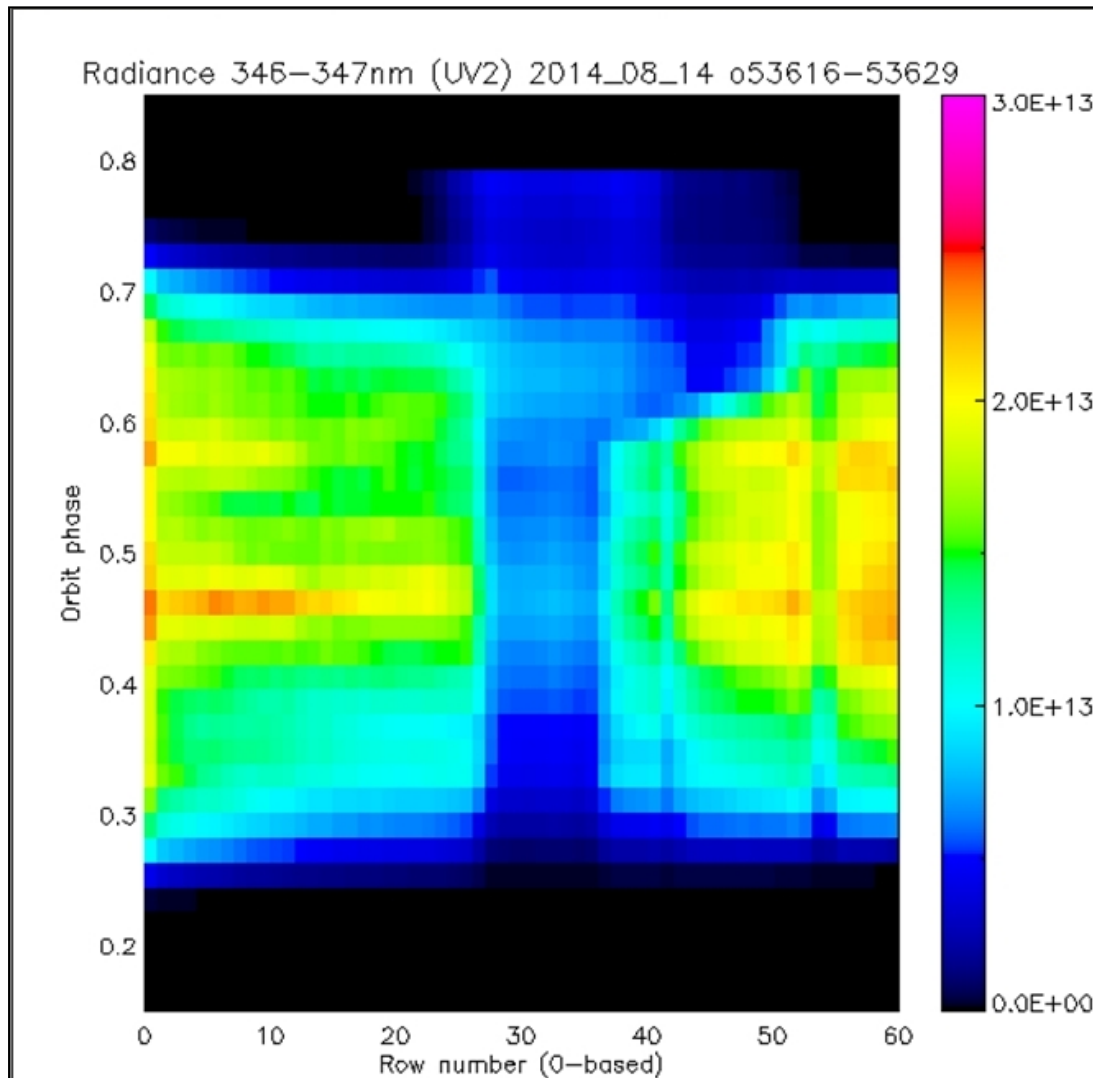
UV2 radiance daily average

August 13

# Instrument Status



## Row anomaly change on August 13, 2014



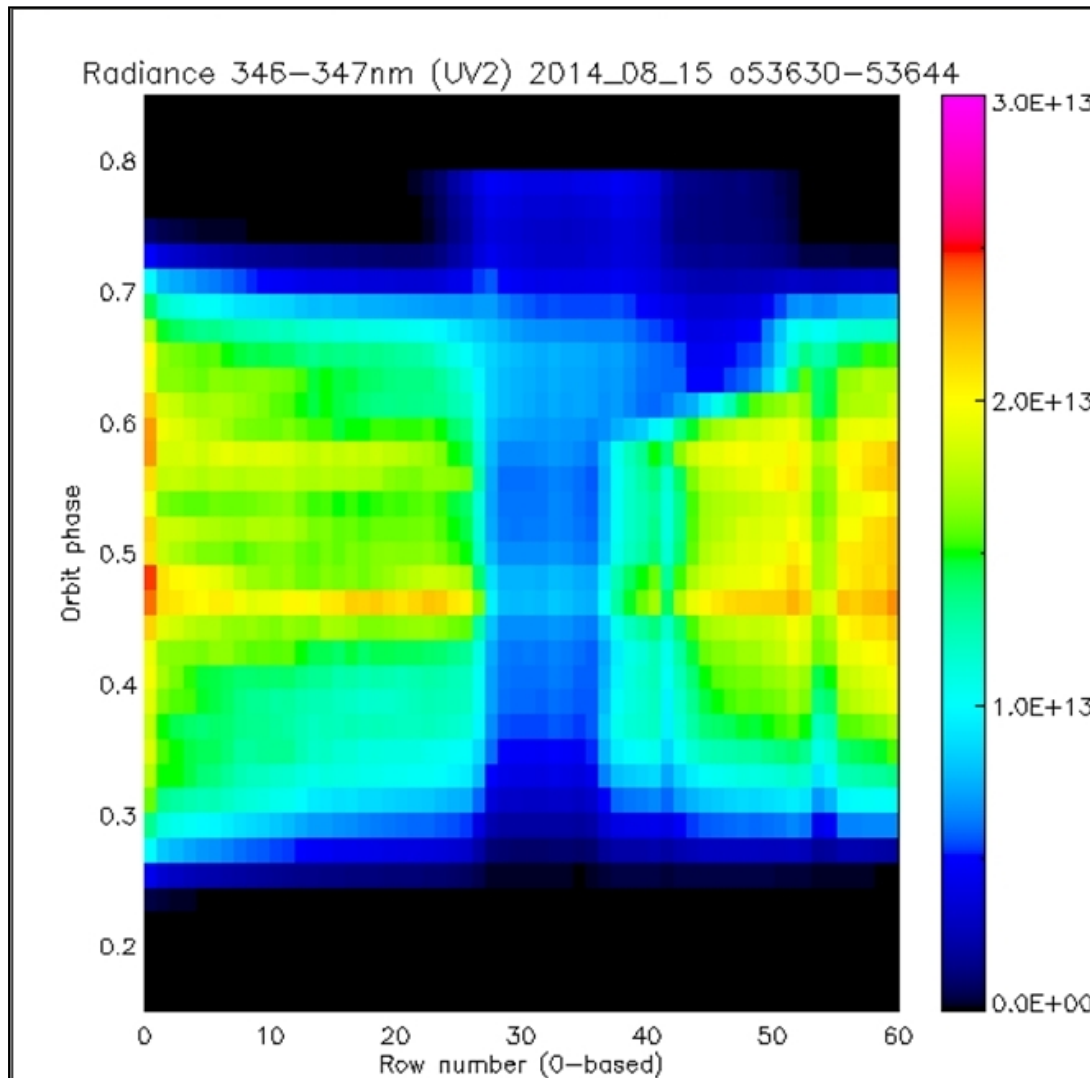
UV2 radiance daily average

August 14

# Instrument Status



## Row anomaly change on August 13, 2014



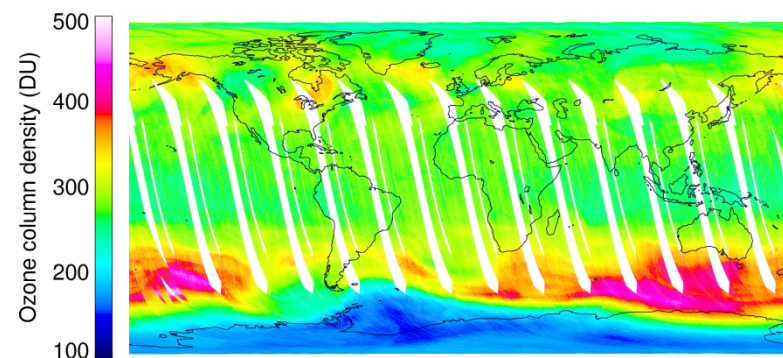
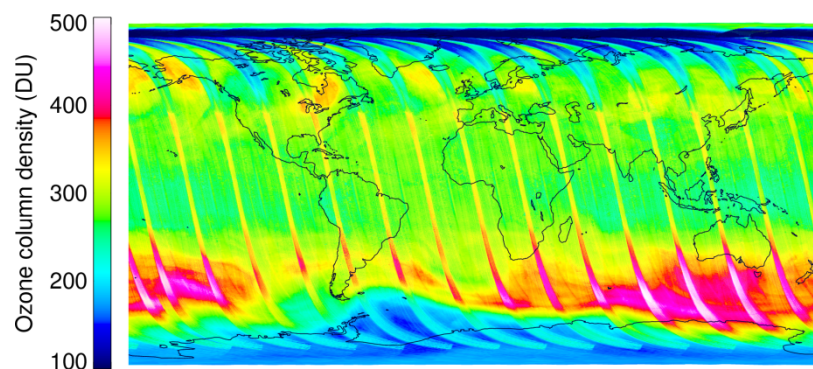
UV2 radiance daily average

August 15

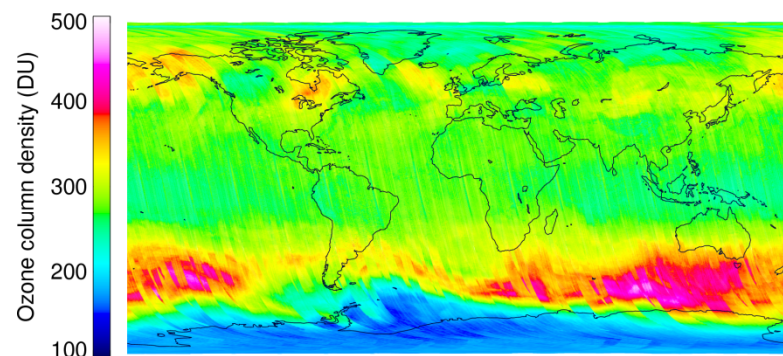




Now daily coverage within 2 instead of 1 day



OMI ozone column density for September 22nd, 2012. Left: unmasked, right masked. There is no daily global coverage anymore due to the row anomaly.

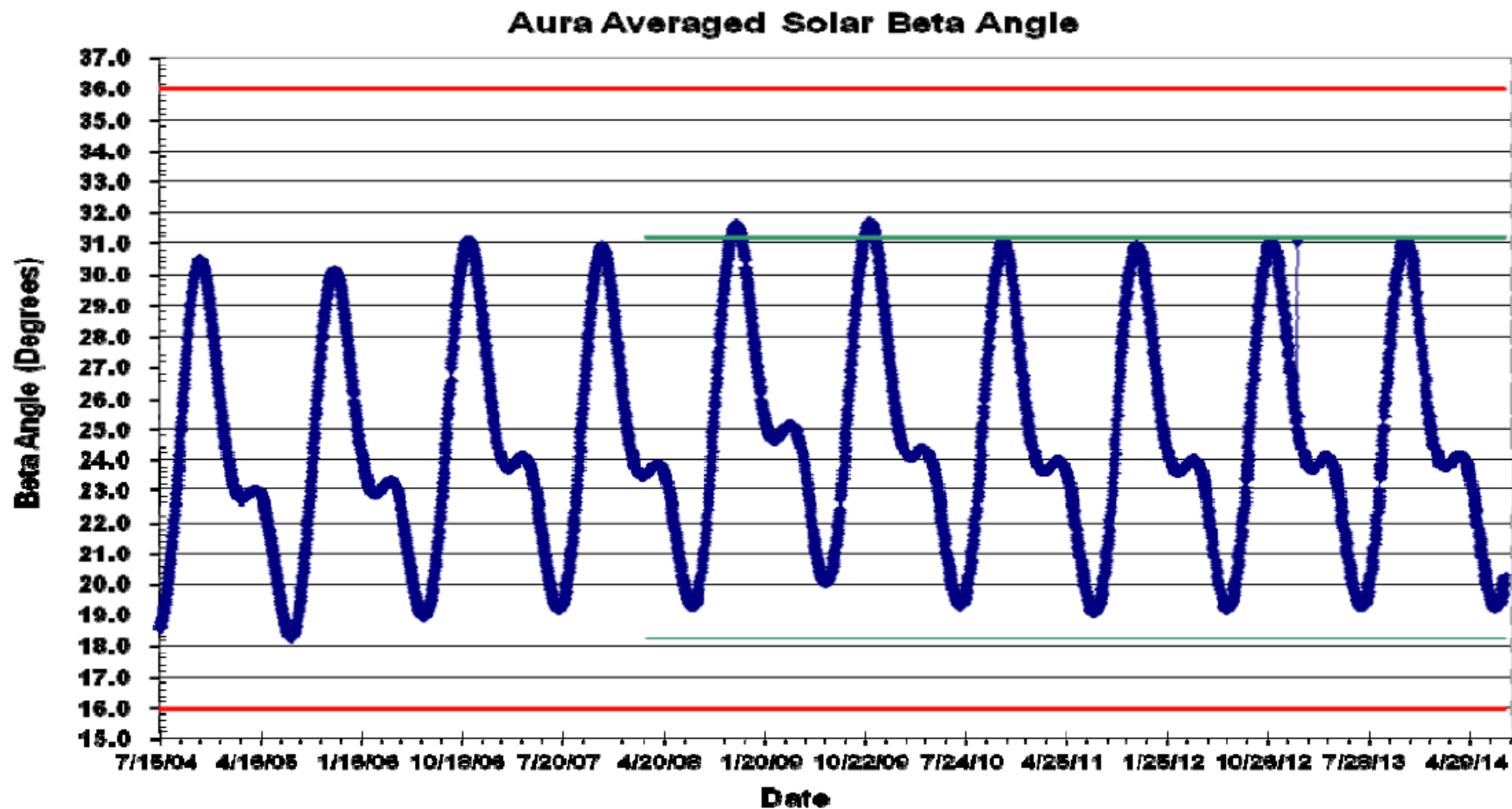


OMI ozone column density for September 22nd plus 23rd, 2012, masked for the row anomaly. This picture shows that global coverage is obtained within 2 days.



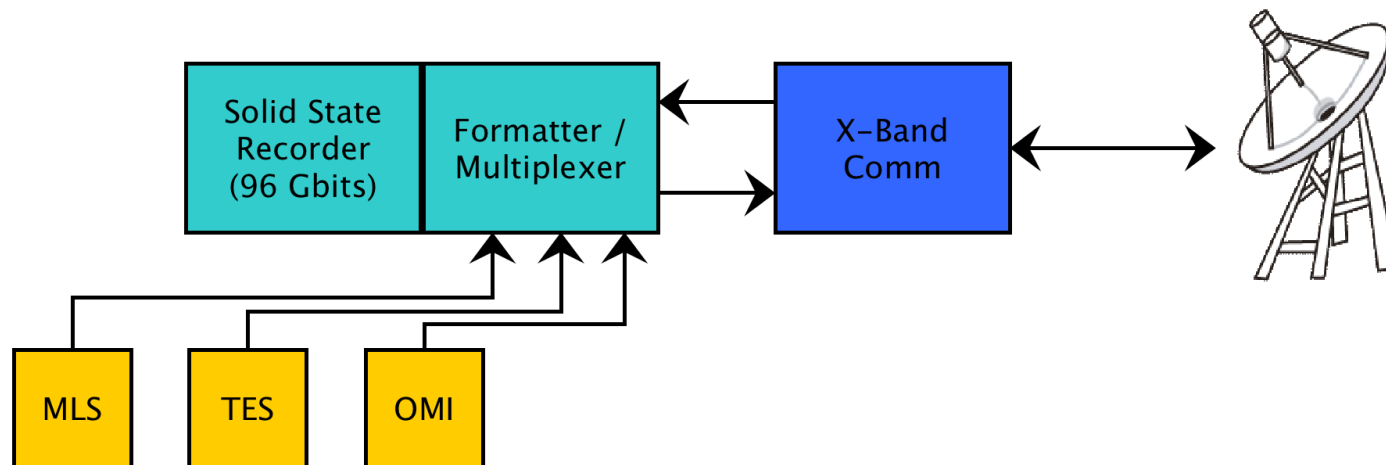


- The solar beta angle is maintained within required limits.





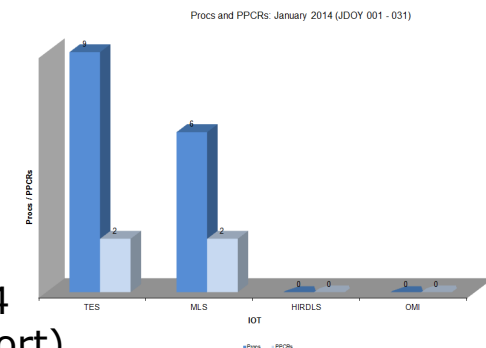
- A FMU anomaly started on Dec. 5<sup>th</sup>, 2007 and is ongoing
- The anomaly causes no science data loss for OMI so far.
- The anomaly impacts the attitude and ephemeris data needed for the L0 -> L1b data processing
- A OMI specific work-around has been implemented: use predicted instead of definitive ancillary data. This works very well.

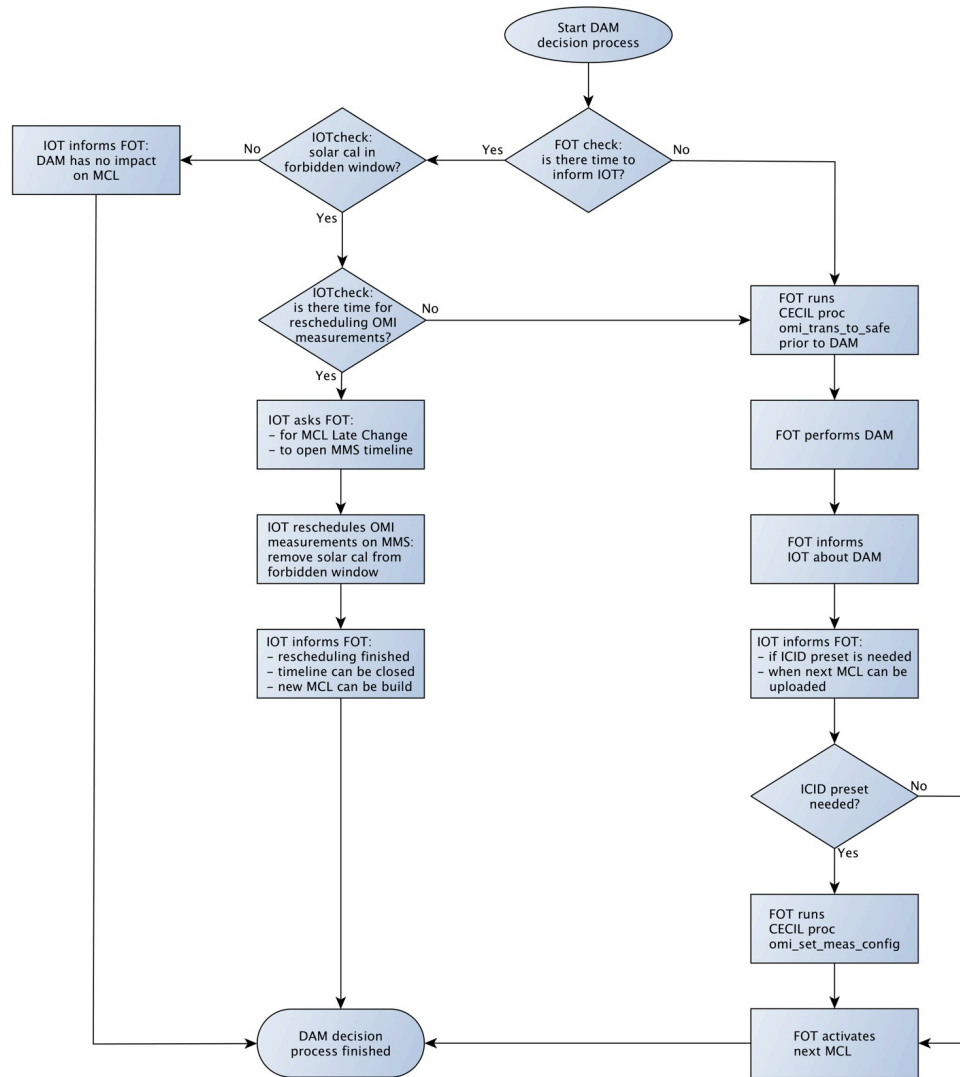




- Almost all measurements (>99%) were according to Nominal Operations Baseline.
- WLS voltage yellow/red upperlimits updated after yellow limit violation
- Permanent data loss for orbit 52573 (June 3<sup>rd</sup>, 2014) due to Poker Flats anomaly.
- Occasional re-scheduling of solar measurements is needed due to S/C thruster maneuvers: avoid contamination of optical parts.
  - MCL for DOY2013/316 was terminated: no time left for rescheduling due to DAM. No loss of science data, only loss of quality.
- Instrument fully operational for more than 99.99% of its time.
- No real-time commanding was needed (last time was on June 27, 2012 for resetting counters after a multi-bit error in IAM memory)

Command activity for January 2014  
(from the Aura Monthly Status Report)





The OMIS-IOT has proposed a new procedure to be followed in case of a Debris Avoidance Maneuver.

# Conclusion



- The instrument status is very good
- The instrument degradation is very slow
- No issues (except for the row anomaly)
- Science data is of very high quality

## OUTLOOK

**The Instrument Operations Team expects to operate the instrument without any problems for the next coming years.**



# Celebrations at KNMI



# OMI 10 years





## BACKUP SLIDES

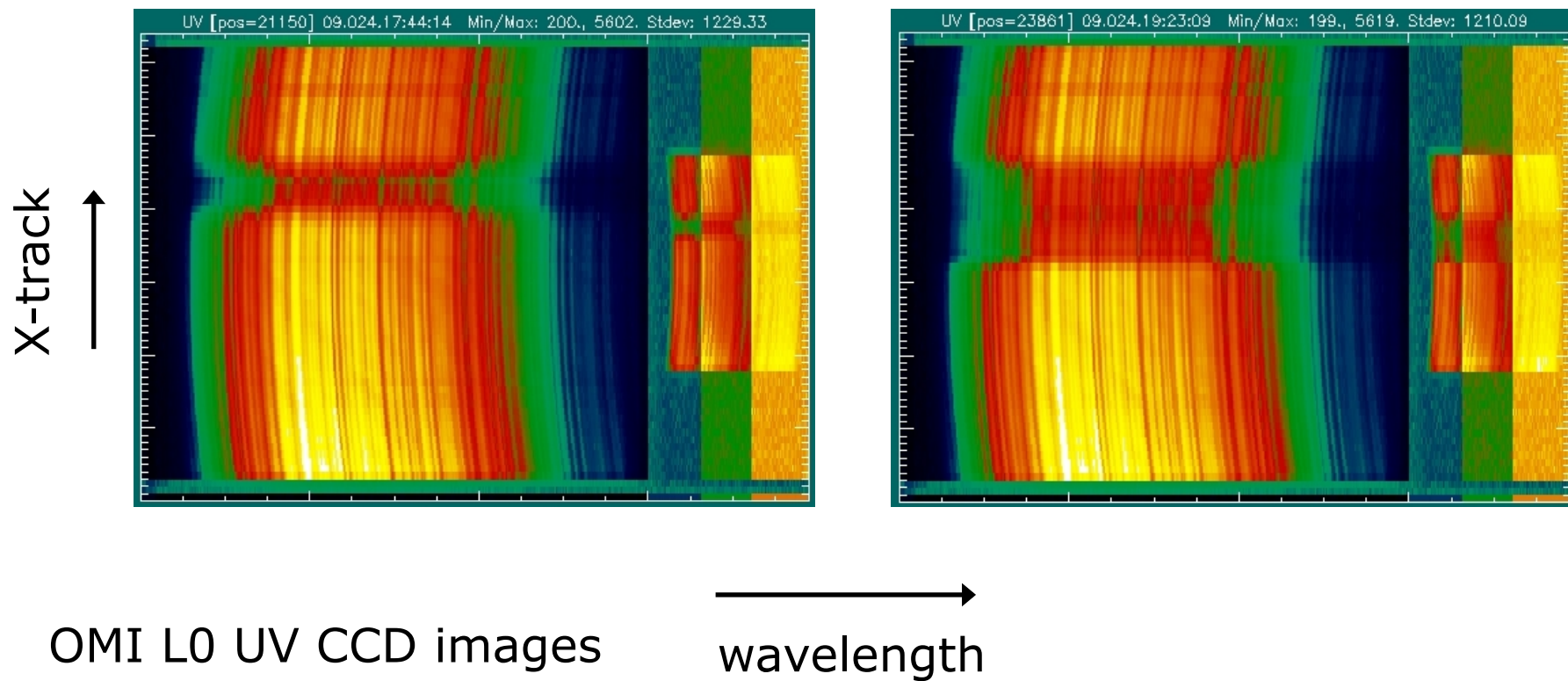




## Row anomaly change on Jan 24, 2009

24jan09/orbit 24092

24jan09/orbit 24093





## White Light Source (WLS) voltage alarm

- On November 23, 2011 there was a upper yellow limit violation of the WLS voltage.
  - Cause: the WLS filament is becoming thinner over time, its resistance is therefore increasing resulting in a higher voltage over the filament.
  - After consulting the instrument builder it was decided to increase the voltage upper yellow and red limits:
    - yellow 13.25 -> 13.75 Volt (will be reached beginning 2020)
    - red 13.50 -> 14.00 Volt
- This was implemented on December 8, 2011

